Chapter 7
Considerations in Representing Human Individuals in Social-Ecological Models

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7.1 Purpose

The most troubling problems in conservation – deforestation, land degradation, biodiversity loss, and climate change – are difficult to isolate and examine as independent phenomena. Increasingly, the view from science casts these as outcomes from complex interactions within and between human society and its biophysical context. Reductionist science is poorly suited for representing such complexity, and that has given rise to multidisciplinary, multi-level systems approaches. This increase in multidisciplinary approaches has created a transformative wave of change as the existing institutions of conservation science absorb, adapt, and give way to innovations that can advance such approaches.

In this chapter, we examine how conservation science that focuses on the human individual – particularly the tradition of social science research that has emerged under the flag of "human dimensions of natural resources" – might fit within a systems approach. Our examination of this topic has a dual purpose: to suggest the implications for (1) how ecosystem sciences can integrate the human individual into dynamic, multi-level models, and (2) how human dimensions research can envision the individual and direct new research initiatives in a broader social-ecological context.

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7.2 Impetus for Change Emanating from Ecological Sciences

Historically, biological traditions have set the direction of natural resources research and that is also the case in the drive toward multi-scale, multi-level and multi-disciplinary approaches. More specifically, this new direction in natural resources research is borne from the shift toward systems science in ecology. C. S. Holling (1998) described the ecosystems approach by contrasting two cultures in the ecological sciences. The traditional approach was reductionist, narrow and targeted, experimentally focused, concerned with Type I error, hypothesis testing and standard statistics. In this culture, the environment is viewed as largely fixed and at a single scale, and causation is considered single and separable. The other fast-emerging culture was seen as broad, exploratory, multi-disciplinary and integrative, and it is focused on multiple lines of converging evidence. It uses non-standard statistics and is concerned with Type II error. It takes a systems view of the environment, describing the environment's dynamic qualities as self-organizing with multiple interactions, and operating at multiple scales.

This systems approach views nature as complex, dynamic, and adaptive. The system reveals both chaos and order, has continuous and discontinuous elements, and is marked by abrupt change (Holling et al. 2002). Hierarchy is central to this conceptualization. Phases of change are proposed to occur within multi-scale, multi-level structures that are nested within a broader hierarchy. The structures move at separate speeds and are multi-directional in their effects. Each level experiences its own change cycle, but slower and larger scales set conditions for faster, smaller ones, whereas the latter are the sites of variation that can generate functional shifts at higher scales. Systems are seen as having varying degrees of resilience – a reference to their ability to retain crucial functions during episodes of change. Adger et al. (2005) suggest that "the concept of resilience is a profound shift in traditional perspectives, which attempt to control changes in systems that are assumed to be stable, to a more realistic viewpoint aimed at sustaining and enhancing the capacity of social-ecological systems to adapt to uncertainty and surprise" (p. 1036).

7.3 A Need for Greater Inclusion of the Individual in Ecosystem Models

Humans were largely absent from the early ecosystem models (e.g., Noss 1990), then were added as macro, driving forces that cause change in biological systems (e.g., Forester and Machlis 1996). But quickly, attention was given to integrating the social component in describing "social-ecological systems" (SES). Broad questions for the social aspects of resilience ask about human response and adaptation, how reorganization follows collapse or sudden dramatic change, and how social learning accumulates (Gunderson and Holling 2002). Political scientists, economists, geographers and anthropologists (Abel and Stepp 2003; Collins et al. 2011; Kok and Veldkamp 2011), working at the group or institutional level, have been quicker to

respond to this trend than were those focused on individuals in the social psychology tradition. Abel and Stepp (2003), for example, called for a new "ecosystems ecology in anthropology", a discipline that has a long history of an ecological approach to cultural change. However, increasingly, the importance of including individuals in the internal dynamics of SES models has been recognized (Redman et al. 2004; Collins et al. 2011). Inclusion of the individual addresses an important weakness evident in SES modeling: representing the capacity of humans to make choices that affect the system. Davidson (2010) suggests that to be fully inclusive of a social component, concepts of resilience will need to account for the fact that, unlike other organisms in an ecological system, humans have the ability to postpone ecological effects, have unequal agency (due to power differentials) and the ability to imagine, anticipate, and invoke collective action.

While research on the individual predominates the published literature in the human dimensions of natural resources (HDNR) area (Manfredo et al. 2004), very little of this work fits readily into the SES paradigm. With few exceptions, most HDNR research is borne from the information processing paradigm made popular in psychology in the 1970s. This paradigm viewed psychological attributes as isolated, static, and enduring and did not account for the influence of factors such as culture or context on cognition (Gardner 1987). More recently, there have been explicit attempts to include individuals in SES models that have focused on finding simple social variables for use in techniques such as agent-based modeling (Janssen and Ostrom 2006; Buizer et al. 2011). Researchers have also proposed concepts or frameworks such as mental models (Jones et al. 2011), consumer preferences (Baumgärtner et al. 2011), and people-environment transactions (Stokols et al. 2013) as ways of representing individuals in SES.

Independent of these efforts, areas such as Cognitive Ecology, Evolutionary Psychology, Social-Ecological Psychology and Cross-Cultural Psychology have led the drive toward more complex, dynamic, adaptive multi-level approaches that might offer guidance in bringing individuals into SES models. Drawing from these areas, we make suggestions about three basic questions in developing approaches for bringing the individual into SES models: (1) is human thought conceptualized as a dynamic and adaptive process, (2) is the individual placed in a multi-level context, and (3) is human thought seen as mutually constructed with the social and natural environment. We address each of these questions throughout the remainder of this chapter.

7.4 Human Thought as Dynamic and Adaptive

Growing threats such as climate change and desertification have prompted concerns about the human ability to anticipate, adapt, and alter behavior to avoid undesirable results. Certainly, history shows that humans are remarkably adaptive. This adaptive success is attributed to our ability to create culture, accumulate knowledge and transmit that across generations. It is the cognitive processes of the human mind that

create outcomes such as technological advances, social collaboration, and institutional invention that generate effective adaptive success. The view from evolutionary psychology would propose that our cognitive systems and fundamental cognitions such as values are critical mechanisms for adapting to our social and ecological surroundings. Even a simple depiction of the dynamic and adaptive nature of thought processes, as we present here, can have meaningful implications for SES modeling.

7.4.1 Dual Adaptive Systems in Humans

Theory suggests there are two separate systems that drive human thought and behavior (Evans and Stanovich 2013). System one evolved early in humans, and responses stemming from it tend to be automatic, fast and intuitive, and non-conscious. System two evolved more recently, and response is slow, requiring working memory and the deliberation of existing knowledge. The first system is developed gradually over time through the process of associative learning, repeat experience, and trial and error. This system accumulates an individual's learning into quick response mechanisms. Given the cumulative process, a single incident is unlikely to have a big effect on the responses of System one; further, the more incidents accumulated, the less likely change is to occur. As a consequence, a significant amount of foundational associative learning occurs in one's early years of life. System one gives a person instantaneous response to a constantly-changing surrounding. For a given motivational or goal state, this system shapes subconscious perception of the environment and its opportunities and dangers. It drives the automatic course of action in a fluid and "online" manner.

System two is based on semantic or symbols-based learning, storage of information, recall and deliberation in new and novel ways. System two is used episodically as needed when a response situation rises to a conscious level. Information that is drawn from the environment and processed with information from memory to anticipate consequences of response can be stored for retrieval at a later time. System two processing is considered *slow in the sense that it requires considerable cognitive effort and time to reach a conclusion*. While it is slow in that sense, it is *fast in its ability to change and adapt to new situations*. For example, where a new incident is unlikely to affect System one processing, new information can readily change an attitudinal and behavioral response borne from System two.

System one is obviously not independent of System two. The foundational aspects of perception, assumptions, and evaluation shape our awareness, understanding, and acceptance of new information. Yet, the two systems are believed to sometimes act in conflict with one another in difficult decision choices (e.g., when a person carefully analyzes pros and cons and has a gut feeling different from the result of that critical analysis). Evidence for the dual systems approach, and the conflict between systems that may arise, is supported by studies that show different areas of the brain are active when different systems are engaged (Goel 2008).

How can the dual systems view be useful in SES? These two systems paint a complex picture of human ability to adapt. On the one hand, System one facilitates continuity and predictability. It is the essence of cultural transmission by which customs, practices and meanings are carried through generations. System two prepares humans for abrupt and sudden changes in their surroundings. It allows people to quickly (relative to the effect of information on System one) assimilate information, weigh it against information stored in memory and develop a response to maximize positive outcomes.

A few examples reveal ways that the dual systems model brings perspectives to conservation problems. Recent articles have indicated that in order to attain social and ecological sustainability, human values and subsequent behavior must change (Burns 2012; Ehrlich and Kennedy 2005; Karp 1996; Vlek and Steg 2007). In some cases, initiatives have been undertaken to change human values. These initiatives will likely face an inordinate challenge, particularly with attempts at traditional rational appeal. As proposed by Kitayama and Uskul (2011), values are not entities but the "water we swim in". They are learned through slow processes of associative learning and reinforced by more explicit, System two learning. Values arise gradually through the continued repetition of cultural practices, stories and myths, beliefs and meanings. They are not merely learned, but are "embrained", or integrated within the mental processes controlled by the brain, and evidence is emerging that suggests there is a genetic basis for such culturally-delineated patterns.

Recent findings exemplify how the long-term durability of values might affect conservation. Manfredo et al. (2013) provide data indicating that Americans' wildlife value orientations can be traced to their ancestry, or country of origin, with shifts in thought patterns occurring slowly as states in the U.S. become more modernized. This view casts doubt on the ability to engineer an effect on cultural values and transfers attention to the key question of how values adapt (and at what rate) to a rapidly changing world. That is, when there is significant interruption in surrounding life circumstances, such as warfare, massive environmental change or migration, how do values affect the adaptation process?

In another example, Weber (2006, 2010) explains that the slow acceptance of climate change may be related to the general lack of personal experience (climate events) that would inform the associative system of risk and produce negative evaluations or feelings such as fear that motivate action. In other words, System one's intuitive influence contrasts with the deliberative process of System two on climate change response. Simply providing more facts will not change the situation. Research by Kahan et al. (2011) offers support for this explanation. Scientific literacy, according to their findings, had minimal influence on perceptions of climate change in America, whereas cultural value effects were strong and guided people's assessment of the credibility of climate change information (suggesting a strong System one influence).

A final example comes from the study of traditional ecological knowledge (TEK), which encompasses empirical knowledge of natural resources, resource management systems, social institutions that guide management, and worldviews that provide meaning to the role of humans in ecosystems (Berkes 1999). TEK is far more than factual information learned cognitively (System two). It is also a

cumulative knowledge system transmitted across generations through associative learning and System one processes. An increasing body of evidence demonstrates that TEK is adapted by each generation and supplemented as new information becomes available through individual and group experiences with resource management (Berkes et al. 2000). In other words, TEK can be thought of as a cultural system and not merely as a body of cognitive information.

We conclude this section by proposing that whether or not the dual systems approach is applied, theoretical approaches and problem statements in SES research should emphasize the dynamic, adaptive nature of human thought. In doing so, research should explore alternative methods to the conventional interview or survey response methodology. This change will undoubtedly be challenging given that research sponsors often request traditional survey methods, HDNR researchers are trained primarily in these methods, and the availability of alternatives is somewhat limited. However, alternatives do exist, and recent examples illustrate the potential of experimental approaches (e.g., game theory), cognitive ability and styles tests, implicit attitude tests, longitudinal studies, and physiological and brain imaging measures.

7.5 The Individual in a Multi-level Context

A systems approach to understanding the individual in SES views "the brain, body and world in coupled motion" (Hutchins 2010, p. 709). Such an approach requires that the researcher reach across scales and influences in explaining human behavior. It requires the adoption of a broad, inclusive meta-theory but also implies non-traditional types of statistical methods (e.g., hierarchical linear modeling, social network analysis, agent-based modeling) and methodological concerns (e.g., the ecological fallacy). Hutchins (2010) has noted that applying systems approaches to understanding real-life behavior in psychology has been challenging. This is in no small part due to the complexity of humans and the near endless permutations of levels of effects. For those working in conservation, the hierarchy applied in research will depend on the way the problem is defined. Here we briefly overview three broad hierarchical categories that will be useful to consider: within the individual, individual-group, and institutional and structural factors.

7.5.1 Hierarchies Within the Individual

Humans are driven by a variety of interrelated processes, and each has a separate literature and breadth of theories including, for example, theories of needs and motivation, perception, cognition and evaluation, affect and emotion, and learning and memory. We understand just a fraction of how these processes operate together,

are formed and adapt people to their social-ecological surroundings. Hierarchical approaches would work toward bridging understanding of the interdependence of these processes and their impact on human judgments, decisions and behavior.

There is little current research in HDNR that takes a hierarchical approach, with one exception – the value-attitude-behavior hierarchy (VAB). VAB research brings together, in hierarchical form, the guiding influence of the more slowly-formed cognitive processes of values (System one) and the more rapid evaluative processes of attitudes (System two). There are a variety of examples of the VAB approach being used in the natural resources arena (e.g., Fulton et al. 1996; Vaske and Donnelly 1999; Hrubes et al. 2001; Oreg and Katz-Gerro 2006; Milfont et al. 2010). An important area for future research will likely explore the contexts in which behavioral response breaks from System one thought patterns (like values in the climate change example above) and information processing takes precedence in defining individual choice.

While VAB and other goal hierarchy approaches became popular in the 1980s, more recent advances reach across various sub-disciplines of psychology, joining self-report cognitive measures with genetic, biological, and physiological measures. The latter have been particularly useful in explaining dual systems models and also supporting evolutionary explanations of human behavior (Goel 2008). As an example of these advancements, Chiao and Blizinsky (2013) provided evidence of the linkage among social-ecological conditions (mental health and disease prevalence), human genetics (serotonin gene transporter), and cultural value types (individualist-collectivist). With data spanning across 29 nations, their research revealed that the Short allele of the 5-HTTLPR was more prevalent in collectivist cultures as an adaptive response to higher levels of disease prevalence. Collectivist cultures and associated customs not only support preventative behavior for disease spread, but they serve to provide social support that mediates the negative emotion and fear avoidance behavior associated with the Short allele 5-HTTLPR.

In another example, Greene et al. (2004) found evidence that personal moral decisions stimulate areas of the brain associated with emotion and social cognition (more primitive responses, available before language) while impersonal moral decisions are related to areas of the brain associated with in-depth processing. Considering its potential to inform future directions in HDNR research, to what extent might this finding be applied to understanding human-wildlife relationships, an area of focus within HDNR? More specifically, as an illustration, to what extent might these different decision paths be associated with mutualism versus domination wildlife value orientations identified in the literature (see Manfredo et al. 2009; Teel and Manfredo 2010)? Moral decisions would typically be those involving humans, but a key difference between those with a mutualism versus domination orientation is that the former views wildlife as family or companions, deserving of rights like humans, while the latter "de-personizes" wildlife. It would be reasonable to pursue the explanation that differences between the value orientation types on judgments about wildlife treatment are rooted in the two different cognitive systems examined by Greene et al. (2004).

7.5.2 The Individual-Group Hierarchy

Humans are driven strongly by social affiliation motives. That tendency has spawned high levels of cooperation and altruism among humans. As Fehr and Fischbacher (2004) note, "human societies represent a spectacular outlier with respect to all other animal species because they are based on large-scale cooperation among genetically unrelated individuals" (p. 185). This tendency is seen to be, in part, an evolutionary response to being prey species for many predators in formative times (Hart and Sussman 2005), and it also posed adaptive advantages for evolving, competitive cultural groups (Boyd and Richerson 2009).

The human need to attach to groups is widely evident. People define themselves through a hierarchy of identities – e.g., friendship groups, sports team groups, chat groups, professions and professional associations, governance groups (local, state, nation), being human, etc. The group itself can be considered an emergent property in systems terms, with characteristics and dynamics beyond the mere aggregation of individuals. The process of attaining group membership is elemental in forming our social world. The processes and effects of group membership are explained through Social Identity (SIT) and Self-Categorization (SCE) theories which Spears (2011) claims are "possibly as close as we come in contemporary social psychology to a grand theory" (p. 208). A social group exists when people share a definition of who they are, how they relate and how they are different from those not in the group. People have many different group identities, and these identities vary in how important they might be to a person and how accessible they are in a given situation. Once a social identity is accessed in a given situation, it is important because it shapes one's social perception of a situation, appropriate social conduct and one's own self-definition. This is a dynamic process, however, because as the situation changes, so might the salience of the identity. For example, a representative of the coal industry and a representative of the environmental community, while in a public debate about global warming, may take on highly adversarial and oppositional identities; yet, in other contexts they may define themselves as members of the same group (e.g., mothers, alumni of the same university, Americans, fans of a given team, etc.). The salience of a given identity is seen as dependent on the situational context as well as a person's commitment to the identity. The more salient and committed a person is to an identity, the more likely that person will act out and seek the identity role (Stryker and Serpe 1982).

The process of self-categorization into a group offers explanation of how social identity affects the thoughts and behavior of the individual. As a member of the group, and contingent on one's commitment and emotional attachment to the group, one will learn or infer the appropriate norms, attributes, and attitudes associated with that group. Norms, which are beliefs about how one ought to behave or think, are a critical aspect of group maintenance. Norms represent ideal or prototypical thoughts or behaviors that unify and ensure compliance and agreement within the group (Turner 1991). As a group member, the person adopts those norms or attitudes in situations where their group identity is salient. Theorists have coined this as "depersonalizing" – a process whereby a person acts in accordance with group norms and perceives oneself as representing the group, not as an individual.

The use of SIT and SCE in understanding environmental topics has been relatively neglected (Twigger-Ross et al. 2003), and yet the available applications offer promise in considering how these frameworks may be integrated into HDNR studies on individual-group dynamics in the future. For example, Bonaiuto et al. (1996) showed that perceptions of beach pollution among samples of youth in six separate resort towns were associated with the person's attachment to either the town or the nation (Great Britain). SIT was borne from an interest in understanding conflict among groups of people, and Stoll-Kleemann (2004) illustrates such a use. The theory was applied in this case to address intergroup conflict among farmers, conservationists and forest managers in biodiversity management in Germany's protected areas. In another application, Carpenter and Cardenas (2011) explored the relevance of social identity in common pool resource experimentation. They found that when students were placed in an experimental context where they knew they were engaged in a cross-cultural "game" situation (i.e., their national social identity was made salient), participants were more likely to represent the country group prototype position: U.S. students were more likely to emphasize conservation strategies in allocating forest resources, while Columbian students tended to emphasize resource extraction.

In a multi-level application, Burton and Wilson (2006) provided an analysis of the shift in Western farming regimes from productivist (focused on maximizing food production) to post-productivist (focused on consumption and sustainability) and multi-functional (both productivist and post-productivist, separated spatially and temporally) regimes. While structural variables (i.e., policy, political economy) would suggest the transition is occurring, the identities that farmers reported did not suggest such a transition at the individual level (i.e., individual farmers sustained an emphasis on production).

SIT and SCE have also been applied in understanding prejudice, conformity, crowding behavior, organizational behavior, leadership deviance and group cohesiveness, all of which are important topics in HDNR (Hogg 2006). There is strong potential for a dynamic model of individual-group involvement in researching conservation topics. The research methodology might involve more intense in-person assessments (e.g., groups, situational salience, group norms and attitudes) across actors and times. Such assessments could serve as the basis for examining the relative influence of group versus independent action on key policy and behavioral outcomes and how groups, individuals, and the environment interact and change in that process.

7.5.3 Institutional and Structural Factors

How do human psychological processes interact with various elements of context such as modes of economy, technological capabilities, power differentials, demographic trends, political structures and ecological conditions? While these questions have received attention since the earliest efforts of the social sciences, they have become mainstream to psychology in only the past couple of decades (Triandis 2007). Here we review just a few of the categories that have received attention in the literature.

7.5.3.1 Economic Development

Economic development has historically been a central focus of social science theory. It is particularly strong as a result of the influence of Marx who had a broad and lasting influence across the social sciences, especially in sociology and political science. A contemporary articulation of his modernization theory is found in Post-materialism theory, as introduced by Inglehart (1997), who focuses on modern-day (post World War II) global cultural change. Inglehart's theory proposes that increases in modernization (wealth, education, and urbanization) reduce the prevalence of subsistence needs among citizens of a nation. As subsistence needs decline, needs for affiliation and self-esteem become more prominent, and as needs change, so do people's values. Materialist values, emphasizing a concern for basic physical and economic security, are replaced by self-expressive (also referred to as post-materialist) values, and in the realm of religion, traditional values are replaced by secular values. This shift in values is proposed to have important implications for many areas of social life (Pippa and Inglehart 2004; Inglehart and Welzel 2005). For example, when materialist values pre-dominate, individuals are more willing to subordinate their own preference for the greater good, but with self-expressive values, individuals tend to pursue their own preference and an active voice in government. This, Inglehart contends, produces a trend toward participatory decision-making and away from hierarchical authority.

Post-materialism theory has been used to address environmental topics in two areas. The first was to provide an explanation for the growth of environmentalism. Inglehart initially proposed that the rise of pro-environmental attitudes was associated with the shift toward post-materialist values: as countries became modernized and less concerned about meeting basic needs, citizens would become more concerned about the environment. Findings from his own data, however, showed a preponderance of pro-environmental attitudes in developing countries (Brechin and Kempton 1994), prompting Inglehart (1995) to suggest that environmentalism will arise: (1) in situations where there are "objective conditions" of increased environmental degradation, but also (2) due to "subjective conditions" of cultural shift, in countries of increasing modernization. This issue continues to be explored in a multi-level context with an interest in understanding the cause of both in-country differences and intra-individual differences in explaining the growth of environmentalism. Findings generally support the chain of events in which an increase in economic well-being brings about a shift toward post-materialist values, and that shift in turn yields a rise in pro-environmental attitudes (Gelissen 2007; Franzen and Meyer 2010; Haller and Hadler 2008).

A second conservation-related application of Post-materialism theory is found in research by Manfredo et al. (2009). These researchers proposed that the changing context of social life has led to a shift from domination to mutualism value orientations toward wildlife in the U.S. While domination prioritizes human well-being over wildlife and promotes treatment of wildlife in utilitarian terms, mutualism views wildlife as capable of relationships of trust with humans and is defined by a desire for companionship with wildlife. This theoretical perspective argued that

the reduced reliance on wildlife for material goods, the human tendency toward anthropomorphizing and a growing need for affiliation in post-materialist society have fueled the trend toward mutualism wildlife value orientations. This shift, in turn, has had an important impact on people's relationships with wildlife and their attitudes toward wildlife policy-related issues. A multi-level study in 19 western U.S. states revealed a strong contextual effect of modernization variables – i.e., individual differences in wildlife value orientation scoring could be explained by state-level influences of urbanization, income, and education. Higher levels of these state-level predictors were also associated with higher percentages of mutualists in a state. Moreover, those with a mutualism versus domination orientation were less likely to favor traditional wildlife management techniques (e.g., lethal control) and participate in recreational hunting, revealing the connection between wildlife value orientations and wildlife-related attitudes and behaviors (Manfredo et al. 2009).

7.5.3.2 Governance Systems

Over the past two decades, a growing body of work has centered around questions of governance in SES research, recognizing the importance of institutional mechanisms in influencing system dynamics and resilience (Gerlak 2013; Anderies et al. 2004; Walker et al. 2004). Broadly, governance can be defined in this context as creating the conditions for collective action and ordered rule as well as the set of formal and informal rules that constitute the social system's institutions (Walker et al. 2006). More specifically, environmental governance, defined as the "set of regulatory processes, mechanisms and organizations through which political actors influence environmental actions and outcomes" (Lemos and Agrawal 2006, p. 298), has received increasing attention in the literature.

An area ripe for research considering the role of the individual is reflected in the move toward new approaches to environmental governance, including adaptive governance or adaptive co-management which relies on collaborative networks that connect individuals, organizations, and institutions at multiple levels for managing ecosystems (Dietz et al. 2003; Folke et al. 2003; Olsson et al. 2004). These approaches build upon the extensive tradition of research on community-based governance of common-pool resources advanced by Ostrom (1990, 1997, 2007a) and others (e.g., see Agrawal 2002; Schlager 2004) and are reflective of the rise in more participatory, decentralized forms of decision-making, or collaborative governance (Ansell and Gash 2007; Rogers and Weber 2010).

Using a series of case studies from Sweden and Canada, Olsson et al. (2004) point out how individual actors and their characteristics, including leadership and trust-building capabilities as well as cultural values and local ecological knowledge, are often a critical component of the self-organizing process that defines adaptive co-management systems. They go on to demonstrate the potential of such systems for building resilience by enhancing community capacity to deal with uncertainty and change. The individual characteristics they identified have also been described as important elements of social capital, a term widely used across the social

sciences to represent the collective capacity of individuals in social networks (Walker et al. 2006; Ostrom and Ahn 2003; Pretty 2003). According to Ostrom and Ahn (2009), social capital can be viewed as "an attribute of individuals and of their relationships that enhance their ability to solve collective-action problems" (p. 20).

In addition to social capital and related elements such as leadership, a host of other factors designed to connect individual and group-level characteristics to governance regimes were identified in a recent SES framework advanced by Ostrom (2007b). Under the category of resource "user" variables, Ostrom included, for example, individuals' knowledge or mental models of the SES, their dependence on the resource and history of use, and socioeconomic characteristics. Recognizing concerns over recommended panaceas or blueprint approaches to the governance of complex social-ecological problems, the framework was intended to serve as a diagnostic tool for analysis by detailing an array of variables posited by prior research and theory (including a review by Agrawal [2001]) to impact patterns of SES interactions and outcomes. While Ostrom cautioned that not all variables would be relevant in every study, demanding an assessment of which variables and at what levels would be relevant in terms of their potential impact on human behavior and SES outcomes, the framework was proposed by the author as "a step toward building a strong interdisciplinary science of complex, multilevel systems" that would facilitate future research to match governance strategies to particular problems in the SES context (Ostrom 2007b, p. 15181).

Emerging work in this area shows the potential for establishing stronger linkages between environmental governance and the psychological characteristics of individuals within a given social structure. For example, Newig and Fritsch (2009) conducted a meta-analysis of 47 case studies to assess the effectiveness of participatory, multi-level forms of governance. While polycentric governance (consisting of multiple centers of decision-making authority) was correlated with environmental outcomes, the environmental preferences of individuals (averaged across all participants) had by far the strongest effect. In another example, Paciotti et al. (2005) examined the linkage between collaborative personality styles and the adoption of social justice institutions in comparing the Sukuma and Pimbwe ethnic groups in Tanzania. Game theory methods showed a much stronger sharing tendency in the Sukuma compared to the Pimbwe. This finding was true in situations of within-group and between ethnic group games. Sharing and trust served as a foundation for the Sukuma institutional form of justice called Sungusungu. The Pimbwe's attempt to adopt this form of governance was simply not successful due to their lack of cooperative style. The researchers suggested that the alignment of personality characteristics and governance styles serves to adapt social groups to their surroundings.

Arguably, as indicated by these examples, psychological research could contribute to further addressing certain individual-level variables and interactions that Ostrom (2007b) and others have identified as well as aid in expanding the list of individual characteristics (including measures of psychological constructs such as values, attitudes, etc.) worth considering in the governance, and broader SES context. In addition, inclusion of governance considerations in HDNR research would expand understanding of the broader institutional and structural factors that can influence individual thought and behavior.

7.5.3.3 Geographic Regions

Geographic variation on psychological attributes has long been an interest in the social sciences (Allik and McCrae 2004; Hofstede and McCrae 2004; Rentfrow et al. 2008). There has been a strong focus on national differences, but differences have also been identified at regional levels (Nisbett 1993; Kitayama et al. 2006; Rentfrow et al. 2008). Attributes found to vary have included personality characteristics, cultural values, and emotional expression. As an illustration, Rentfrow et al. (2008) revealed how the "Big 5" personality characteristics varied considerably at the state level across the U.S. Further, state-level personality correlated strongly with other social quality variables such as crime rate, social involvement, and religiosity (all increased with levels of extraversion).

While the geographic differences found in such studies are interesting, the real value of their findings is the provocation to explain, or theorize, why these differences exist. For example, Rentfrow et al. (2008) proposed that the explanation for geographic variation in their study was tied to "founder migration" – non-random groups of people with distinct attributes and perhaps genetic make-up settling in an area. The characteristics in a region are perpetuated through selective migrations (people moving to the area) and social and environmental influences. Similarly, Nisbett (1993; Nisbett and Cohen 1996) suggested geographic differences in white male violence could be attributed to cultural factors associated with historical patterns of economy and migration. Kitayama et al. (2006) also relied on a similar cultural mechanism to explain regional differences when comparing "frontier" settlement areas with other areas across nations, but Kitayam and Uskul (2011) went on to argue that cross-cultural psychological and behavioral differences are the result of complex interactions among different systems that make up human individuals (genes, brains, minds) and collectives (social networks, cultures, broader environments). As these examples reveal, understanding geographic differences in psychological attributes will require holistic theorizing and multi-level approaches that recognize the complexity of the human context. Recent advances integrating culture in psychological research, discussed in more detail below, offer promise in informing new directions in this area (Oishi et al. 2009; Kitayama and Cohen 2007).

7.5.3.4 Cultural Groups

Cross-cultural psychology emerged in the 1960s and 1970s, and as recently as 1998 Segall et al. (1998) proclaimed "psychology in general has long ignored 'culture' as a source of influence on human behavior and still takes little account of theories or data from other than Euro-American cultures" (p. 1102). Yet, cross-cultural psychology has given fresh insight into the pursuit of identifying human universals, considered one of the primary goals of psychology (Jahoda and Krewer 1997). Interestingly, the growing body of cross-cultural research has found that many of the central theories of psychology, which originated from research in North America, have not generalized well to other cultures (Norenzayan and Heine 2005).

But the contrasting goal of psychology, understanding diversity, has been well served by cross-cultural psychology, and the logic for such diversity coincides with the main goal of an SES approach – determining the adaptive interrelationships of humans and their environments. As Triandis (2007) states:

> [people]…determine ways of organizing information, symbols, evaluations, and patterns of behavior; intellectual, moral, and aesthetic standards; knowledge, religion, and social patterns…systems of government, systems of making war; and expectations and ideas about correct behavior that are more or less effective [functional] in adapting to their ecosystem. (p. 64)

Further, the methods and theory of cross-cultural psychology can be key to informing SES approaches to conservation issues that include individuals and account for their varied cultural backgrounds.

One area of research in cross-cultural psychology that has received enduring attention is the diversity of cultural values and understanding why they exist (e.g., Hofstede 2001; Schwartz 2006). This research has been guided by practical concerns of improving intergroup relations, increasing success in global markets, and international diplomacy. A frequent focus in this area has been on the documented difference between the collectivist values of Southeast Asian cultures and the individualistic values of cultures of Europe and North America (Triandis 1995). Two recent studies illustrate the social-ecological nature of the explanation for this difference, highlighting the relevance of cross-cultural psychology in an SES context as well as the potential for this sub-discipline to inform future directions in HDNR research aimed at understanding the broader influences on individual thought/behavior. Kitayama et al. (2010) proposed a production-adoption model of cultural change which they used to explain the strong individualistic and independence "ethos" in the U.S. They argued that novel values and practices arise within a social group to cope with major adaptive challenges for biological, economic, and/or political survival, whereas adoption of existing practices is motivated by a desire to achieve prestige and higher status within one's community. In the U.S., values and practices associated with independence and self-reliance emerged as settlers moved West and had to adapt to sparsely-populated, harsh environmental conditions. Given the economic success of Westward expansion, residents in the Eastern U.S. imitated these values in achieving higher social status and prestige.

In another recent example, Gelfand et al. (2011) proposed exploring the collective-independent difference through a cultural systems model of "tightness-looseness" that links ecological threats, social processes (norms and tolerances of deviant behavior), socio-political institutions, and psychological processes. Overall, based on empirical findings with data from 33 nations, they suggested that as ecological and human threats increase, the need for strong norms and punishment of deviant behavior also increases because these mechanisms facilitate social coordination in response to the threats. Such coordination enhances the chance of survival. Given that institutions are a reflection of norms and tolerances, societies with strong norms ("tight" nations) would have more restricted press, more laws, criminal justice systems with higher monitoring and severe punishment, and

stronger religion, while "loose" nations would be the opposite. Also, in tight cultures, there is a higher degree of structure and constraint in day-to-day situations as well as individual-level psychological adaptations like self-regulation and self-monitoring.

7.6 Mutually Constructed Nature of Human Thought and the Social and Natural Environment

Implicit in this question is the assumption that the structure and organization of individual thought serves to adapt humans to their social-ecological surroundings. This assumption has been an emphasis since the origins of psychology and, more recently, a particular focus of evolutionary psychology. Schwartz (2006) proposed, for example, that value orientations serve to guide people in a cultural group in how to maintain the individual-group relationship, how to act to preserve the social fabric, and how to manage relationships with the natural world. As another illustration, Fredrickson and Branigan (2001) argued that while negative emotions have served to support basic survival, positive emotions are believed to have fostered exploration, expansion and pioneering among humans. A final example is research by Uskul et al. (2008) who showed different ecological niches occupied by humans affect economic activities, which, in turn, produce different cognitive styles that help adapt human activities to the niche.

What is generally missing in this literature is the feedback effect that human adaptation has on the environment, an essential aspect of SES modeling. The criticism that ecology has not looked at the reciprocal effects of humans and the environment can be applied equally to the social sciences. This is one of the critical challenges for the future recognized by Oishi and Graham (2010) who introduce "socio-ecological psychology", which would examine "how mind and behavior are shaped in part by their natural and social habitats and *how natural and social habitats are in turn shaped partly by mind and behavior* [emphasis added]" (p. 356).

A better understanding of reciprocal effects will be difficult to obtain without research taking on an expanded time frame that might be achieved by: (1) the integration of ethnographic and historical perspectives with traditional social psychological approaches (e.g., Haggerty and Travis 2006), and/or (2) the increased use of longitudinal research (e.g., Boone and Galvin, Chap. 9, this volume). A classic example of the former is Rappaport's (1968) *Pigs for the Ancestors: Ritual in the Ecology of a New Guinea People*. Rappaport based the book on his ethnographic work with the Tsembaga, a group of Maring speakers living in the highlands of Australian New Guinea (now Papua New Guinea). He presented a systems approach that proposed beliefs about religion and the resultant rituals served as the regulatory mechanism creating a homeostasis among the Tsembaga, other human groups, and the environment. The rituals served to maintain biotic communities, limit warfare among groups, provide a basis for establishing allies, and distribute protein (from a ritual involving the widespread slaughter of pig populations) throughout the local

population at the time of greatest need. While Rappaport's work was criticized on a number of counts, the simplicity and elegance of his account led to it becoming a classic. It provided a compelling story of humans in a social-ecological system with ideology serving a central, adaptive role.

At present, there is little emphasis on the dynamic interplay of human thought and the social-ecological context. Far more abundant when it comes to research on the social aspects of SES is literature that: (1) is normative, with an emphasis on ways to increase collaborative approaches to governance; (2) includes individual-level variables that give token representations of human influences in a system; and (3) consists of broad-based conceptual and structural models that depict broad categories of individual-level variables and feedbacks, with sparse articulation of specific effects. More uncommon, but emerging, are approaches that predict how people will behave when given new information or a particular set of circumstances, which in turn creates a myriad of social, policy and ecological outcomes (see Boone and Gavin, Chap. 9, this volume; Fischer et al. 2013). Approaches to SES that adequately represent the mutual construction of society, individuals, and the environment are arguably one of the most important goals for the future.

7.7 Conclusion

The ultimate purpose of an SES approach is to inform questions about human resilience and adaptation in the face of environmental change. Humans' remarkable success in adaptation to date is linked to cognitive abilities of innovation, social learning, and combining different sources of information into new understandings of the world (Cosmides and Tooby 2002; Boyd et al. 2011). Is there some way that we can understand and direct that innovation toward effective mitigation? The emergence and adoption of social innovation is a topic of new and growing interest among conservation researchers, particularly in response to climate change (Nicholls and Murdock 2012; Rodima-Taylor et al. 2012). Yet, it is also a topic that has received considerable attention in organizational sciences over the past four decades, where it is generally believed that innovation is necessary for long-term organizational success (Hage 1999; Willis and Mastrofski 2011). Meta-analyses in this area suggest that in team situations, innovation is related to process variables such as support for innovation, vision, task orientation, and external communication (Hülsheger et al. 2009). In another analysis of innovation in work situations, Hammond et al. (2011) found a complex mix of factors produced innovation, including individual factors, characteristics of the job, and environmental factors. Other literature reviews have found inconsistent and inconclusive results among the many empirical studies (Wolfe 1994; Anderson et al. 2004). Anderson et al. (2004) concluded that: (1) future research should look at innovation processes as cyclical, longitudinal, and iterative; and (2) context and a multi-level approach (individual-group-organization-culture) are critical for exploring this topic. Interestingly, this proposal converges on the conclusion that broadly-generalizable panaceas for complex social-ecological problems are simply not forthcoming (Ostrom 2007b).

It leads us to conclude that an understanding of adaptation and innovation in SES should attend to the considerations we raise here: the dynamic aspects of human thought, the importance of individuals' involvement with and attachment to groups, and the influence of a broad array of social and ecological contextual variables.

We began this chapter by suggesting that a more complete inclusion of individuals in SES models has implications for both ecosystem science and HDNR researchers. The role of humans in the conceptual approaches of ecosystem science has moved through phases of increasing integration over the past three decades. Initially, humans were viewed as external to ecosystems; then humans were seen as drivers of impacts to ecosystems. More recently, humans have been cast as active agents that impact and respond to ecosystems that are in constant shift. We are just beginning to move toward a fully integrative view that humans are participants in a co-constructed, co-evolving, dynamic system. The complexity of social systems is in need of more attention in SES models which will remain poorly specified until there is a representation of the multi-level context of human individuals. We support the view that individuals occupy a unique and central role here – they are the primary unit of evolutionary succession; and causal processes, both up and down scales, must circulate through them (Schank 2001). In other words, change at other social levels aggregated upward, such as cultural evolution, institutional change, technological advances, innovation, etc., all must occur in the minds and actions of individuals.

Ecosystem science sees the system as hierarchies nested within broader hierarchies, each operating at different speeds and cycles of change. For those in HDNR, we propose that such an approach works well for examining individuals in their social-ecological context. We propose a view of the psychological attributes of the individual as dynamic, in a multi-level context, and mutually constructed with society and environment.

We conclude by reinforcing the importance of understanding the role of human individuals in the complex social-ecological interactions that produce daunting global environmental challenges such as climate change, land degradation, and loss of biodiversity. The impacts of humans on ecosystems are registered one behavior and one individual at a time. But each behavior exists in a somewhat patterned tapestry of behavioral choices across many individuals, across time and space. A better understanding of human behavior in its broader tapestry is important if our science is to effectively inform decisions that influence resilience to growing environmental stress.

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